
UNIVERSITI PUTRA MALAYSIA

# SOME ASPECTS OF THE BIOLOGY AND POPULATION DYNAMICS OF GOATFISH, *Upeneus spp*. IN TERENGGANU WATERS, PENINSULAR MALAYSIA

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By

PRIYANTO RAHARDJO

Thesis Submitted in Fulfilment of the Requirements
for the Degree of Master of Science in the
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## DEDICATION

**This work is dedicated to my late father Drs. Hj. Soegito Gito Sudarmo (deceased during my study, innalillahi wa inna ilaihirraji'un).**

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**SOME ASPECTS OF THE BIOLOGY AND POPULATION DYNAMICS OF GOATFISH, *Upeneus* spp. IN TERENGGANU WATERS, PENINSULAR MALAYSIA**

**By**

**PRIYANTO RAHARDJO**

**JANUARY 1997**

**Chairman : Assoc. Prof. Dr. Hj. Mohd. Zaki Mohd.Said**
**Faculty : Faculty of Fisheries and Marine Science**

Two species of goatfish or Biji nangka, *Upeneus sulphureus* and *U. bensasi* play a significant role in the demersal trawl fishery in the Terengganu waters. Estimation of their population parameters, i.e., growth, reproductive behaviour, mortality rate, and assessment of the effect of changes in exploitation pattern were carried out, and alternative management measures for the fishery were examined.

Growth parameters were estimated based on modal progression analysis of length frequency distributions. Data on sexual maturity and seasonal changes in the gonadosomatic index were used to elucidate the reproductive biology of the two species. Length-based catch curves were used to estimate total mortality rate (Z) while empirical and indirect methods were used to estimate natural

mortality rate (M). Relative yield per recruit as a function of exploitation rate E, (E= F/(F+M)), ratio of natural mortality M and Von Bertalanffy growth parameter K, (M/K), and size at first capture (*Lc*), was used to analyze the effects of variability in the controlled variables E and/or *Lc*.

Estimates of the growth parameters derived from eight different methods were K = 0.80 to 1.45, L∞ = 218.08 to 232.00 mm for *U. sulphureus* and K = 0.90 to 1.38, L∞ 228.00 to 243.31 mm for *U. bensasi*. Estimates of total mortality derived from three different methods employed varied (Z = 3.30 to 5.93 for *U. sulphureus* and Z = 2.65 to 5.57 for *U. bensasi*) so considerably that the validity of the methods was questioned. Further validation of the results derived from the length-based method is necessary. Estimates of natural mortality derived from three different methods for *Upeneus sulphureus* (M = 1.01 to 2.53) were less varied than for *Upeneus bensasi* (M = 1.18 to 2.84).

Finally, consideration of management policy using an $E_{0.1}$ criterion (analogous to $F_{0.1}$) showed that the current level of exploitation rate (E =0.63) for *U. sulphureus* exceeded the estimate of the $E_{0.1}$ level (E =0.57), while for *U. bensasi* (E=0.51) it was below the $E_{0.1}$ level (E=0.67).

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains.

**BEBERAPA ASPEK BIOLOGI DAN DINAMIK POPULASI IKAN BIJI NANGKA, *Upeneus* spp. DI PERAIRAN TERENGGANU, SEMENANJUNG MALAYSIA**

**OLEH**

**PRIYANTO RAHARDJO**

**JANUARI 1997**

**Pengerusi : Profesor Madya Dr. Hj. Mohd. Zaki Mohd. Said**

**Fakulti : Fakulti Perikanan dan Sains Samudera**

Dua spesis ikan biji nangka atau goatfish, iaitu *Upeneus sulphureus* dan *Upeneus bensasi* memainkan peranan yang penting dalam perikanan demersal pukat tunda di perairan Terengganu. Penganggaran parameter populasi seperti tumbesaran, perlakuan pembiakan, kadar mortaliti dan maklumat berkenaan dengan kesan perubahan dalam corak eksploitasi dijalankan. Selain daripada itu, penilaian kepada pengurusan alternatif kepada perikanan ini juga diselidiki.

Parameter tumbesaran dianggar berdasarkan model analisis progresi taburan frekuensi panjang. Data kematangan seks dan perubahan musim dalam indeks gonado-somatik digunakan untuk menerangkan pembiakan biologi

kedua-dua spesies tersebut. Keluk penangkapan berdasarkan panjang digunakan untuk menganggar jumlah kadar mortaliti (Z), manakala kaedah tidak langsung dan emperikal digunakan untuk menganggarkan kadar mortaliti semulajadi (M). Hasil relatif bagi setiap pengambilan sebagai fungsi kepada kadar eksploitasi E, (E = F/(F+M)), nisbah kadar mortaliti M berbanding parameter tumbesaran Von Bertalanffy K, (M/K), dan saiz tangkapan pertama (*Lc*), digunakan untuk menganalisis kesan kepelbagaian dalam kepelbagaian kawalan E dan atau *Lc*

Lapan kaedah yang berlainan digunakan untuk menganggarkan parameter tumbesaran, dengan K = 0.80 hingga 1.45, $L\infty$ = 218.08 hingga 232.00 mm untuk ***Upeneus sulphureus*** dan K = 0.90 hingga 1.38, $L\infty$ = 228.00 hingga 243.31 mm untuk ***Upeneus bensasi***. Anggaran bagi jumlah mortaliti diperolehi daripada tiga kaedah yang berlainan telah digunakan (Z = 3.30 hingga 5.93 untuk ***Upeneus sulphureus*** dan Z = 2.65 hingga 5.57 untuk ***Upeneus bensasi***) menunjukkan perbezaan yang boleh diterima sehingga kesahihan kaedah tersebut dipersoalkan. Pengesahan selanjutnya keatas keputusan yang diperolehi daripada kaedah yang berdasarkan kepada panjang adalah diperlukan. Anggaran keatas mortaliti semulajadi yang diperolehi daripada tiga kaedah yang berbeza untuk ***Upeneus sulphureus*** (M = 1.01 hingga 2.53) mempunyai perbezaan yang kurang bagi ***Upeneus bensasi*** (M = 1.18 hingga 2.84).

Akhir sekali, Pengurusan yang menggunakan kriteria $E_{0.1}$ ( anologos kepada $F_{0.1}$) menunjukkan kadar eksploitasi pada tahap terkini (E=0.63) untuk *Upeneus sulphureus* adalah jauh melebihi paras anggaran oleh $E_{0.1}$ (E = 0.57), manakala bagi *Upeneus bensasi* (E = 0.51), nilainya adalah lebih rendah daripada paras $E_{0.1}$ (E = 0.67).

# CHAPTER I

# INTRODUCTION

## Background

Malaysia lies within the latitude 1° N to 8° N and longitude 100° E to 119° E comprising Peninsular Malaysia, Sabah and Sarawak. Peninsular Malaysia is bounded by Thailand in the north, Singapore in the south, South China Sea in the east and Sumatra to the west. Sabah and Sarawak are located on eastern Kalimantan island. The two land masses, Peninsular Malaysia and Sabah and Sarawak are about 1,200 $km^2$ apart separated by the southwestern portion of the South China Sea. The coast line of Sabah, Sarawak and east coast of Peninsular Malaysia lie next to the South China Sea, while the west coast is bordered by the Andaman Sea to the north and Java Sea to the south.

Fishing industry plays an important role in the social economy of Malaysia. It supplies two-thirds of the total animal protein consumed by the population (Merican, 1980). Furthermore, adequate supply of protein rich food is vital to health, especially for the lower income groups.

Also, it contributes to the national income through earnings from foreign exchange of fish and fishery products.

The marine fisheries can be categorised as municipal and commercial fishing. Municipal or sustenance fishing occurs in the inshore waters using either powered or non-powered vessels. The powered vessel can be with an out-board engine or in-board engine.

The commercial fisheries operate in waters beyond the inshore areas. The gears used included otter trawls, purse seines, gill nets, drive-in-nets (muro-ami), traps, hooks and lines and others. Operation of this category is normally beyond 12 mile zone but within the continental shelf, except for some purse seining and drive-in net operations. At present, the total landings of marine fish from Malaysia amount to 930,049 metric tons, 27.45% of which are from the east coast and 46.44% from west coast (Ministry of Agriculture Malaysia, 1995).

Based on the behavioural pattern of fish resources, marine fishing in Malaysia can be categorised into pelagic and demersal fisheries. Pelagic fisheries are mainly concentrated on the migratory species and these are sometimes seasonal in nature. The main gear is the purse seine that has accounted for 17.00% of the total landings of marine fish in Peninsular Malaysia in 1994 (Ministry

of Agriculture Malaysia, 1995). The demersal fisheries are mainly concentrated on the bottom and sometimes mesopelagic species.

The most important and widely used gear in demersal fisheries is the trawl net. The trawl catch contributes the most tonnage in demersal fisheries landings, accounting for as high as 90.00% of the total landing. This share in marine landings has been increasing since the establishment of fisheries. In 1994, the trawl landings were 587,928 metric tonnes, which accounted for 54.00% of the total marine fish landing in Peninsular Malaysia (Ministry of Agriculture Malaysia, 1995).

## Research Problems

Aquatic living resources such as goatfish resources are limited but renewable. Exploitation of these resources must be carefully planned, because after a certain level of exploitation the renewal of the resources cannot keep pace with the removal caused by fishing, and a further increase in exploitation level leads to reduction in yield. For example, the annual catch of goatfish decreased from about 4,900 mt in 1988 to 2,000 in 1991, while the number of fishing days (Fishing effort) increased from 275,471 to 346,388 (Figure 1).

The development of the fishing activities (including trawl fisheries) cannot be pursued indefinitely without giving serious concern to the status of the stocks.